

Math

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*Creating futures,
Changing lives*

MATHS

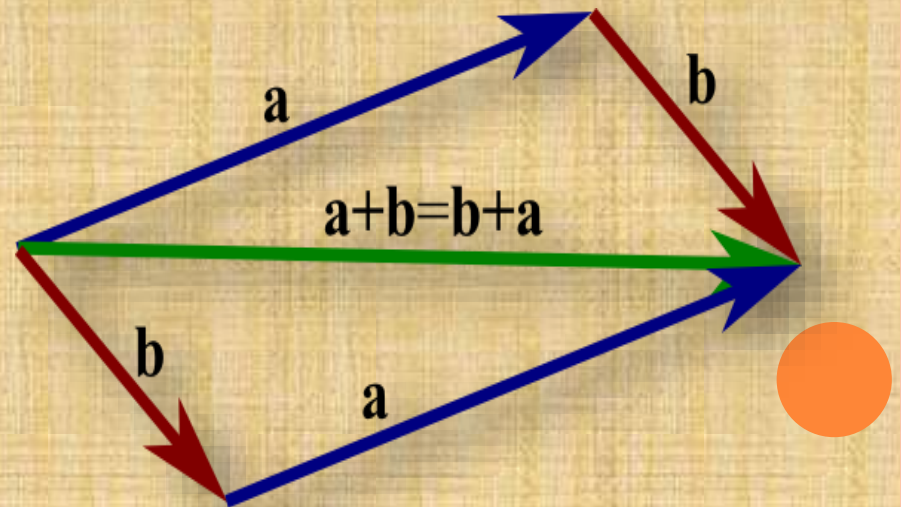
ASSIGNMENT

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vectors

- A quantity possessing both magnitude and direction, represented by an arrow the direction of which indicates the direction of the quantity and the length of which is proportional to the magnitude.
We can represent vectors in our games to determine how to move entities in relation to each other.



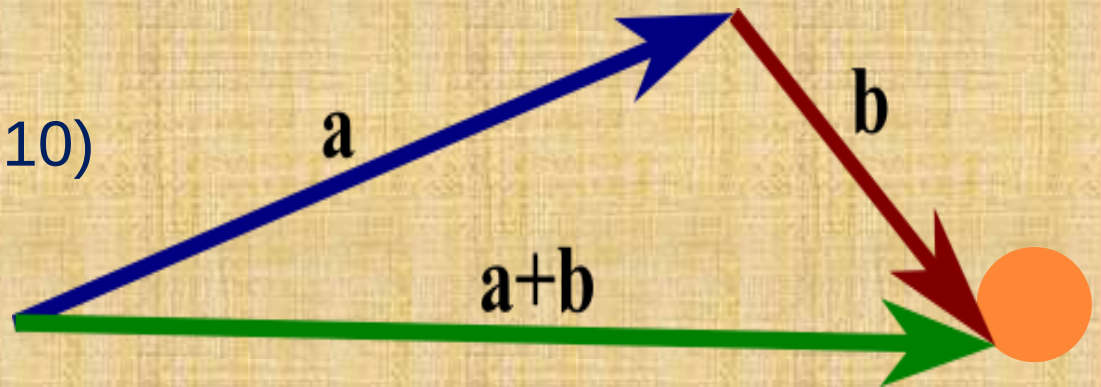
VECTORS

- **Magnitude**
- The size, extent, or length of a Vector.
- **Direction**
- The position or orientation of a vector.
Vectors point into different directions in space.



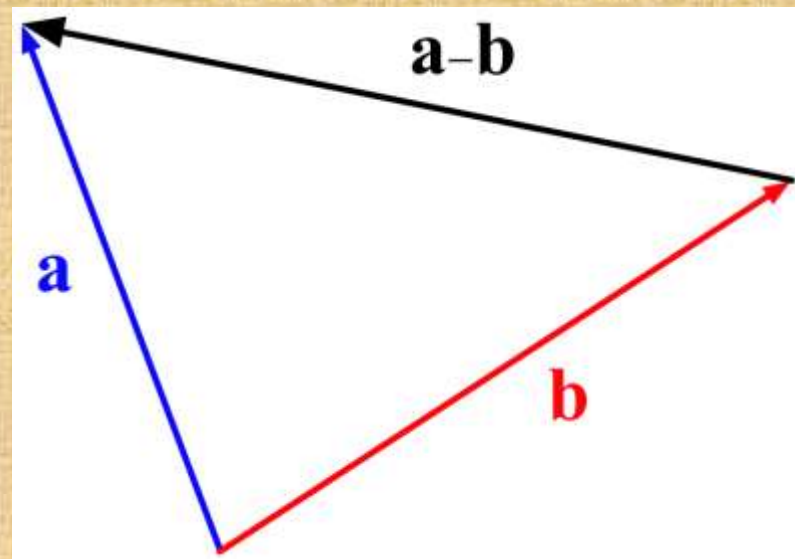
VECTOR ADDITION

- Two vectors can be added together to form a new vector. To perform vector addition, add the x and y coordinates.
- **Syntax:**
- $(v1.x + v2.x, v1.y + v2.y) = (v3.x, v3.y)$
- Example:-
- $v1 = (3,4)$
- $v2 = (4,6)$
- $v3 = (3+4,4+6) = (7,10)$



VECTOR SUBTRACTION

- Two vectors can be subtracted from each other to form a new vector. To perform vector subtraction, subtract the x and y coordinates.
- **Syntax**
- $(v1.x - v2.x, v1.y - v2.y) = (v3.x, v3.y)$
- **Example**
- $v1 = (4,2)$
- $v2 = (3,1)$
- $v3 = (4-3, 2-1) = (1,1)$



UNIT VECTOR

- In mathematics, a unit vector can be computed for any vector. A unit vector has the same direction as its parent but its length is 1 (the unit length). The unit vector is very important in video games.
- **Syntax:**
- Unit Vector = (x / magnitude, y / magnitude)
- **Example:**
- v1 = (3,4)
- Magnitude = 5
- Unit Vector = (3/5, 4/5)

$$\hat{a} = \frac{\vec{a}}{|\vec{a}|}$$



SCALAR VECTOR

- A vector can be multiplied or scaled by a number (scalar) to grow or shrink its magnitude.
- **Syntax**
- Scaled Vector = ($x * \text{num}$, $y * \text{num}$)
- **Example**
- number or scalar = 3
- $v1 = (3,4)$
- Scaled Vector = $(3*3, 4*3) = (9,12)$



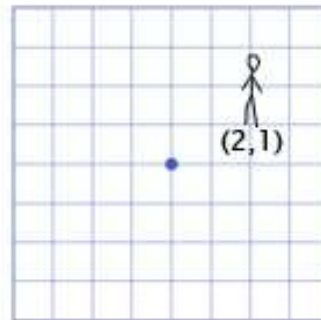
APPLICATION OF VECTORS

- From my research I have concluded that vectors can be used in many field such as navigation of aeroplane, ship and satelite,they are also used in gene cloning ,they are widely used in mechanics, physics and computer engineering.
- They are also used in graphics by creating a smaller and adding them to get an real object
- I am going to tell you about how vectors is used in today's 2D and 3D gaming technology.

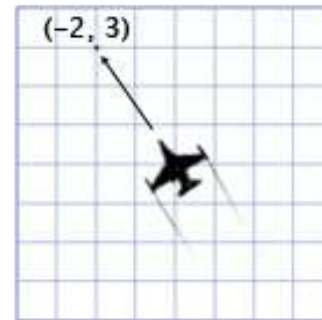


VECTORS IN GAMING

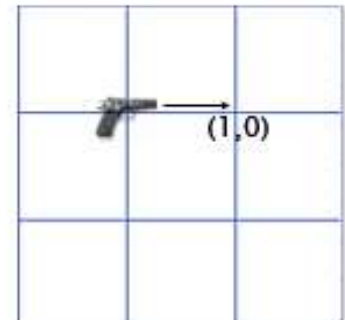
- In games, vectors are used to store positions, directions, and velocities. Here are some 2-Dimensional examples:
- The position vector indicates that the man is standing two meters east of the origin, and one meter north. The velocity vector shows that in one minute, the plane moves three kilometers up, and two to the left. The direction vector tells us that the pistol is pointing to the right.



Position



Velocity



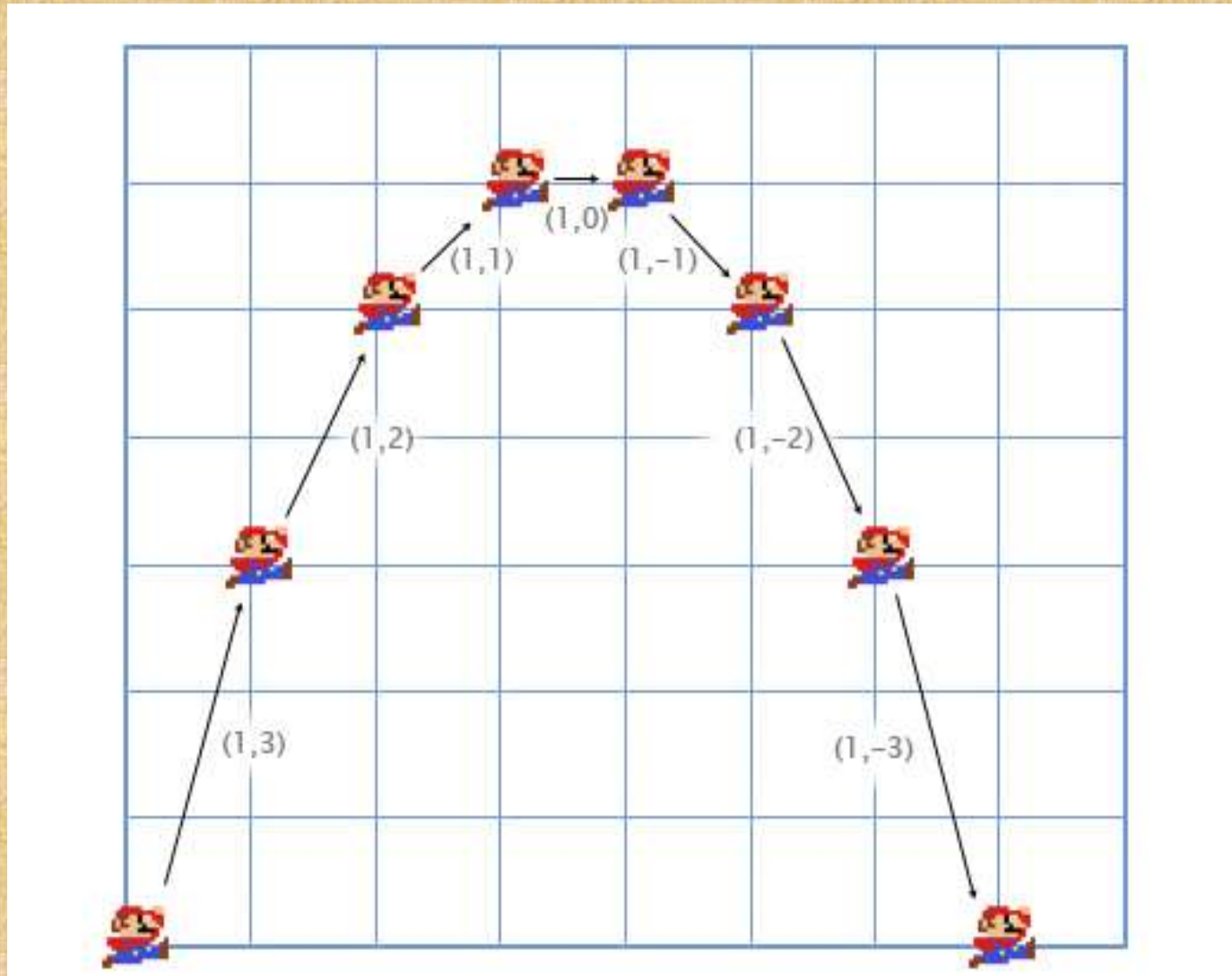
Direction

Vector addition

- Let's consider the example of Mario jumping. He starts at position $(0,0)$. As he starts the jump, his velocity is $(1,3)$ -- he is moving upwards quickly, but also to the right. His acceleration throughout is $(0,-1)$, because gravity is pulling him downwards. Here is what his jump looks like over the course of seven more frames. The black text specifies his velocity for each frame.
- We can walk through the first couple frames by hand to see how this works.
- For the first frame, we add his velocity $(1,3)$ to his position $(0,0)$ to get his new position $(1,3)$. Then, we add his acceleration $(0,-1)$ to his velocity $(1,3)$ to get his new velocity $(1,2)$.



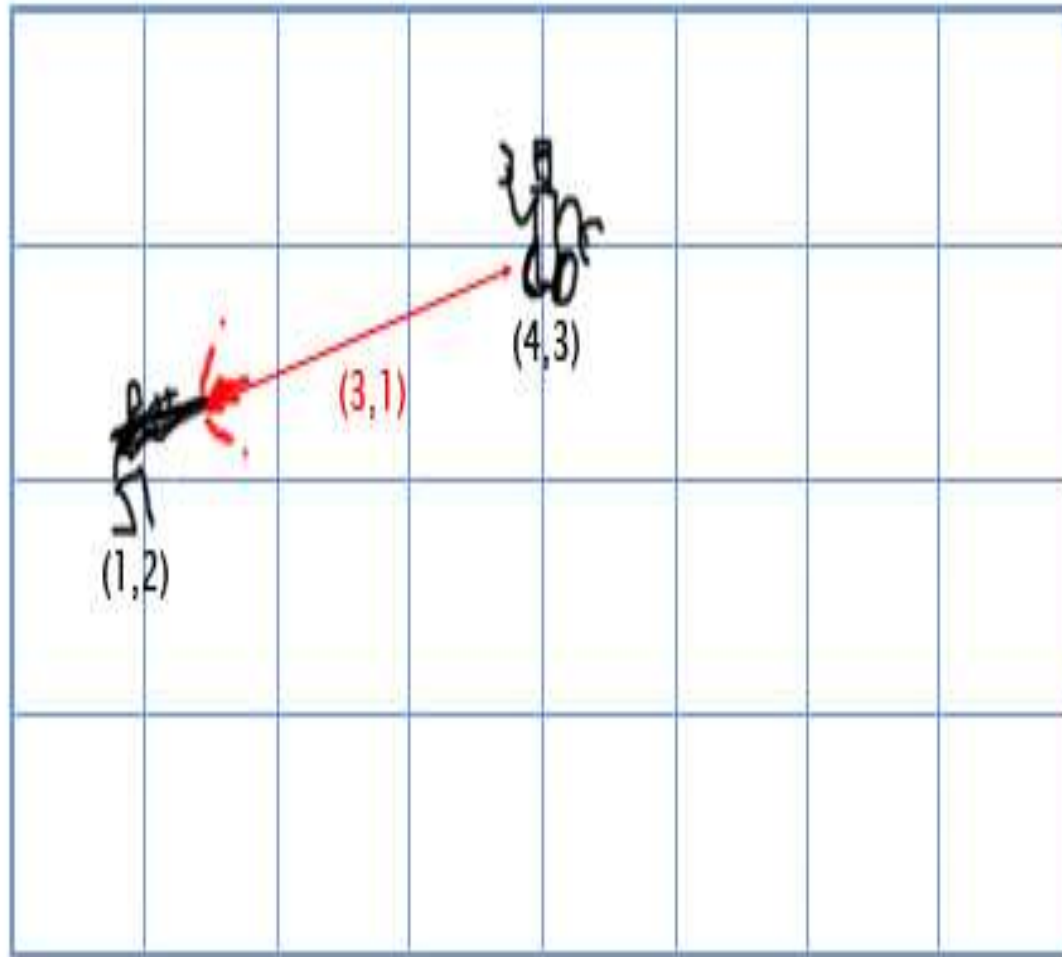
We do it again for the second frame. We add his velocity (1,2) to his position (1,3) to get (2,5). Then, we add his acceleration (0,-1) to his velocity (1,2) to get (1,1).



VECTOR SUBTRACTION

- Subtraction works in the same way as addition -- subtracting one component at a time. Vector subtraction is useful for getting a vector that points from one position to another. For example, let's say the player is standing at (1,2) with a laser rifle, and an enemy robot is at (4,3). To get the vector that the laser must travel to hit the robot, you can subtract the player's position from the robot's position. This gives us:
 - $(4,3)-(1,2) = (4-1, 3-2) = (3,1)$.



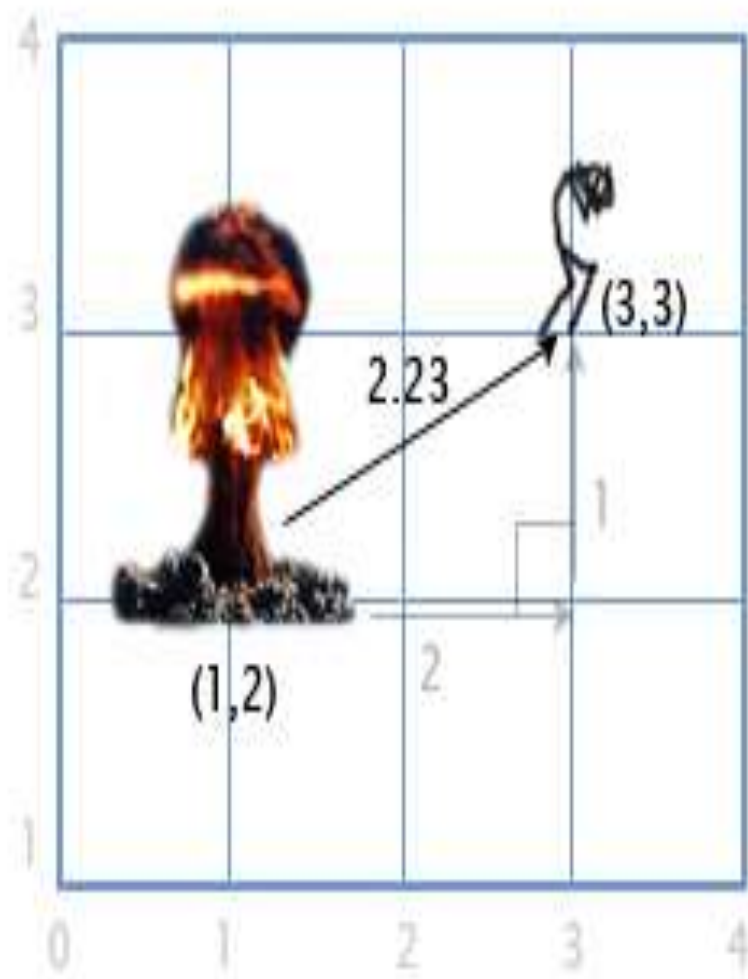


DISTANCE

If the player P is at (3,3) and there is an explosion E at (1,2), we need to find the distance between them to see how much damage the player takes. This is easy to find by combining two tools we have already gone over: subtraction and length. We subtract P-E to get the vector between them, and then find the length of this vector to get the distance between them. The order doesn't matter here, $|E-P|$ will give us the same result.

- Distance = $|P-E| = |(3,3)-(1,2)| = |(2,1)| =$





Vector in Graphics

- Vector graphics are based on vectors (also called paths or strokes), which lead through locations called control points or nodes. Each of these points has a definite position on the x and y axes of the work plane and determines the direction of the path; further, each path may be assigned a stroke color, shape, thickness, and fill. These properties don't increase the size of vector graphics files in a substantial manner, as all information resides in the document's *structure*, which describes solely how the vector should be drawn.



7x Magnification

Vector



Bitmap



- Reference sites and books
 - GE Hay, *Vector and Tensor Analysis*
 - B Hoffmann, *About Vectors*
- <http://www.gamasutra.com>
- <http://www.gamedev.net>
- <http://www-cs-students.stanford.edu/~amitp/gameprog.html>
- <http://www.cc.gatech.edu/gvu/multimedia/nsfmmedia/cware/graphics/toc.html>
- www.GDCONF.com

